

Date: December 7, 2004

To: Project Management Team

From: I-15 Corridor Plan Team

1.0 Introduction

This memorandum summarizes existing traffic conditions throughout the I-15 study area. Overall, the analysis indicates traffic is currently operating reasonably well on the I-15 mainline but there is congestion at some of the ramp terminal intersections that in turn cause operational problems on the ramps themselves. Future growth in traffic will result in increased congestion and delay. The memorandum is comprised of two major sections, namely the I-15 corridor itself, and the surface street network.

2.0 I-15 Corridor

This section of the memorandum provides a summary of the existing traffic conditions in the I-15 study area. The study corridor includes I-15 between 200 North (SR-273) in Kaysville to 31st Street (SR-79) in Ogden and includes the area between the Wasatch Mountains and the Great Salt Lake. Included in this summary are:

- Existing 2004 p.m. peak hour turning movement traffic volumes
- Ramp terminal intersection levels of service (LOS)
- Highway Capacity Software (HCS) merge/diverge analysis
- Permanent count station data
- HCS mainline analysis

Thus far the traffic analysis has not included the intersections adjacent to the ramp terminal intersections. However, because of their close proximity, these intersections have a direct effect on the operational conditions at the ramp terminal intersections. In some circumstances, queuing from closely spaced intersections is blocking movements at the ramp terminal intersections. This congestion is not represented by the deterministic operational tools being used during this initial phase of operational analysis. Fully stochastic simulation tools can better model these types of traffic conditions but require additional input data and are more labor intensive, as such, the detailed analysis is typically only performed in more focused locations within a study area. At this stage of the study, this extra investment in analysis performed over an entire study area does not provide meaningful value.

2.1 Data Collection Efforts

The data collection efforts to date for this project have been extensive. This section of the memorandum describes which collected data were used to perform the analysis of existing conditions along the I-15 corridor. This data is primarily intersection turning movement counts of the p.m. peak period and use of automatic traffic recording (ATR) data. A majority of the

data necessary to complete this analysis was provided by the Utah Department of Transportation (UDOT). However, this was supplemented with data gathered by the consultant for use in other studies. Table 1 summarizes the data collected, the date it was collected, and the source.

Table 1
I-15 Kaysville to Ogden
Traffic Date Summary

Location	Date Collected	Day	Time Period	Source
<i>ATR #348</i>	Continuous	Continuous	Sept. '03	UDOT Permanent Count Station
<i>SR-273/NB Ramps</i>	11/14/00	Wednesday	4-6 p.m.	Commuter Rail -EIS
<i>SR-273/SB Ramps</i>	04/14/04	Wednesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-126/Fort Lane</i>	04/20/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-126/SB Ramps</i>	04/21/04	Wednesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-232/NB Ramps</i>	04/06/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-232/SB Ramps</i>	04/06/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-108/NB Ramps</i>	03/30/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-108/SB Ramps</i>	03/30/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-193/NB On Ramp</i>	03/05/03	Wednesday	4-6 p.m.	Commuter Rail-EIS
<i>SR-193/NB On Ramp</i>	03/05/03	Wednesday	4-6 p.m.	Commuter Rail-EIS
<i>SR-193/SB Ramps</i>	02/20/03	Thursday	4-6 p.m.	Commuter Rail-EIS
<i>SR-103/NB Ramps</i>	03/11/04	Thursday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-103/SB Ramps</i>	03/11/04	Thursday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-97/NB Ramps</i>	03/09/04	Tuesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-97/SB Ramps</i>	03/10/04	Wednesday	3-6 p.m.	UDOT – Turn Movement Counts
<i>SR-26/NB Ramp</i>	3/08/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR-26/SB Ramp</i>	3/08/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>I-15 to I-84 connection</i>	Traffic on Utah Highways: UDOT publication			I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 NB to EB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 WB to NB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 NB to WB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 EB to SB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 SB to WB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 WB to SB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 SB to EB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS
<i>SR 79 EB to NB Ramp</i>	3/22/01	Thursday	3-6 p.m.	I-15 North 31 st Street to 2700 North - EIS

NB = Northbound, WB = Westbound, SB = Southbound, EB = Eastbound

Source: Fehr & Peers, September 2004.

The collected traffic counts were recorded during different months of the year and over the course of recent years. The American Association of State Highway and Transportation Officials (AASHTO) recommends adjusting counts to approximate the 30th highest hour used for design. The UDOT permanent count station data provides estimates for the 30th highest hour based on a percent of average annual daily traffic (AADT) (Figure 2 shows variations by month). UDOT and consultant counts were adjusted to represent average yearly conditions. If needed, older traffic counts were increased to the base 2004 study year using a linear growth rate. This growth rate was determined by reviewing historic traffic growth along the specific corridors.

Traffic count summary sheets, existing signal timings, and lane configurations can be found in Appendix A.

Once the traffic data was adjusted, it was balanced to represent a closed system. A closed system means that traffic between interchanges balance. For example, the traffic between northbound and southbound ramps should match (traffic leaving one ramp terminal intersection equals traffic entering the next). It is not uncommon to have a slight variation in traffic counts between adjacent intersections when counts are performed on different days. Table 2 shows the final result of the adjustments. The final mainline and ramp volumes are shown on Figure 1.

In addition to peak hour traffic volumes, manual field observations of the traffic conditions were performed. This visual observation was completed to provide additional information about the traffic conditions. Observations were performed over the course of several days and during the peak period, generally defined as the time between 4:00 p.m. and 6:00 p.m. Notes were taken to document observed traffic constraints. The observations and notes were supplemented with digital video recordings of traffic conditions.

Table 2
I-15 Kaysville to Ogden Study
2004 PM Peak Hour Traffic Volumes

Location	Eastbound			Westbound			Southbound			Northbound		
	L	T	R	L	T	R	L	T	R	L	T	R
<i>ATR #348 N of I-84</i>								3090			4113	
<i>SR-273/NB Ramps</i>	241	1483			837	637				272		420
<i>SR-273/SB Ramps</i>		918	187	227	882		806		219			
<i>SR-126/Fort Lane</i>	14	415			433	213	216		23	529	355	92
<i>SR-126/SB Ramps</i>	96		18					494	183			
<i>SR-232/NB Ramps</i>	358	684			649	221				422	2	539
<i>SR-232/SB Ramps</i>		906	352	299	722		136		481			
<i>SR-108/NB Ramps</i>	477	1323			1123	489				476	7	306
<i>SR-108/SB Ramps</i>		1431	464	211	1388		369		428			
<i>SR 193/NB On Ramp</i>	446	1065			1353	437						
<i>SR 193 NB Off Ramp</i>	30	1035			1383	107	136		158	249	88	83
<i>SR 193/SB Ramps</i>		1127	267	231	1122		384	5	404			
<i>SR-103/NB Ramps</i>	382	147			727	352				817	4	15
<i>SR-103/SB Ramps</i>		467	395	290	1254		62	15	316			
<i>SR-97/NB Ramps</i>	146	233	343	5	640	16	224	1	159	319	48	67
<i>SR-97/SB Ramps</i>		708	500	133	985		14	2	309			
<i>SR-26/NB Off Ramp</i>		1730			2534							1107
<i>SR-26/SB On Ramp</i>		1730			1461	1073						
<i>I-15 to I-84 Ramps</i>			634			571		3090			3542	
<i>SR 79 NB to EB R.</i>		1010										743
<i>SR 79 WB to NB R.</i>					720	381						
<i>SR 79 NB to WB R.</i>					720				204			
<i>SR 79 EB to SB R.</i>		764	351									
<i>SR 79 SB to WB R.</i>					226				89			
<i>SR 79 WB to SB R.</i>					226	698						
<i>SR 79 SB to EB R.</i>		764										430
<i>SR 79 EB to NB R.</i>		1010	184									

NB = Northbound, WB = Westbound, SB = Southbound, EB = Eastbound

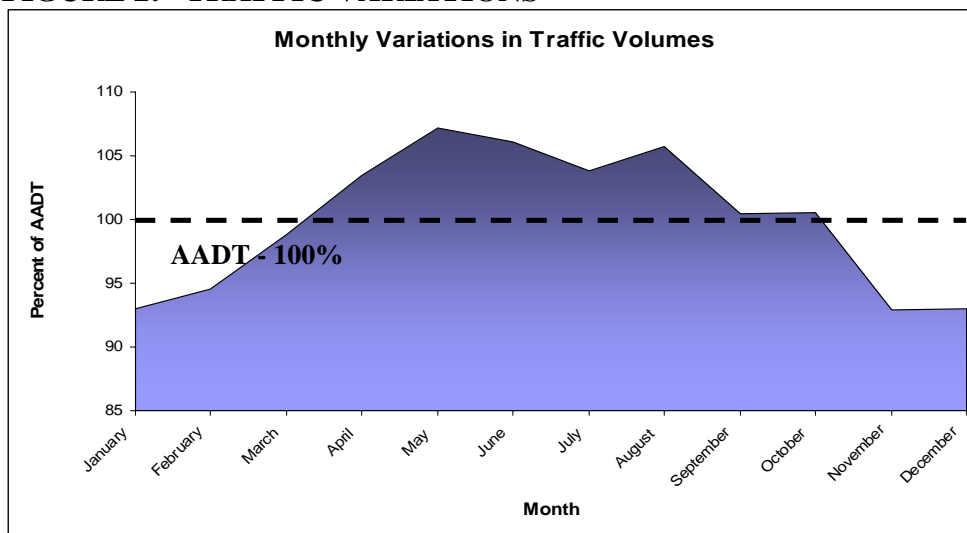
Source: Fehr & Peers, September 2004.

UDOT maintains traffic counting or monitoring stations throughout the state. These stations provide valuable traffic statistics including average traffic count by weekday (Monday through Friday) and by weekend (Sunday through Saturday) for each month of the year. They also provide the 1st, 10th, 20th, 30th, 50th, and 100th highest peak hour traffic count and the corresponding percent of AADT. The data is available for 1993 to 2003. Within the study area, UDOT has two monitoring stations: station #348, located on I-15, ½ mile south of the 31st Street Interchange; station #316 located on US-89, south of Antelope Drive. The information provided by station #348 provides relevant traffic statistics for this study, including:

- Monthly/seasonal variations
- Truck percentages
- Hourly traffic flows
- Directional traffic flows

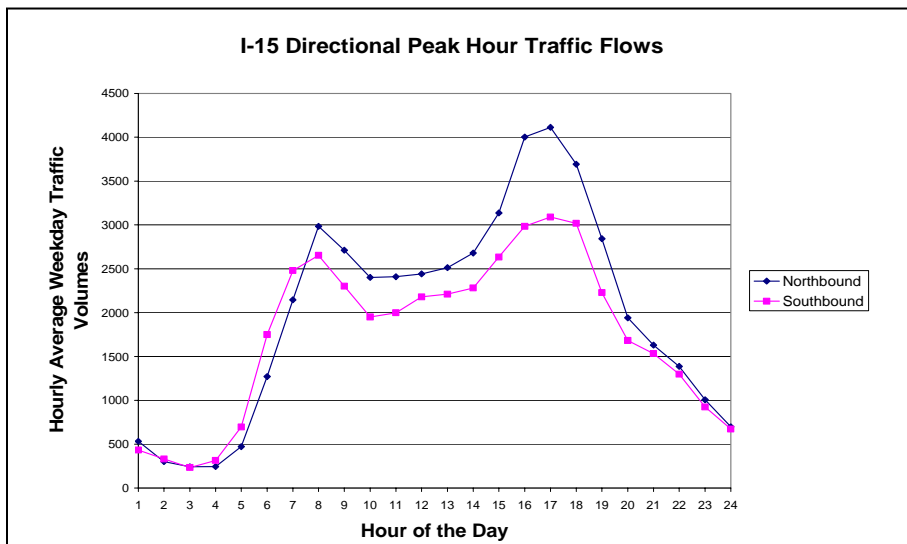
Figures 2 and 3 show the monthly traffic variations and peak hour traffic flows, respectively. Monthly traffic variations were used to adjust collected intersection turning movement counts in order to represent AADT. Figure 3 shows that, in both directions on I-15, the p.m. peak period is the period during the day with the highest traffic volume. This is why this analysis examines only the p.m. peak period. The p.m. peak hour is the analysis hour for both northbound and southbound travel.

FIGURE 2: TRAFFIC VARIATIONS



Source: Fehr & Peers, September 2004.

FIGURE 3: I-15 MAINLINE TRAFFIC VOLUMES



Source: Fehr & Peers, September 2004.

Peak hour traffic volumes gathered from the permanent count stations were used to generate I-15 mainline traffic volumes along the study corridor. These values were used in the freeway mainline analyses and ramp merge/diverge analyses. The hourly traffic flows and AADT adjustments will provide valuable data in evaluating the feasibility of each of the future study alternatives.

UDOT truck percentages were gathered and used in this analysis. Trucks can have a substantial impact on freeway flow conditions because of their size, acceleration, and braking abilities. UDOT estimates truck percentages at the link level by extrapolating statistics generated by the permanent count stations supplemented with spot point data collection. The results of the data indicate that truck percentages along I-15 currently range from 7% at the south end of the study area to 13% north of the I-84 & I-15 connection. These values were used in the freeway mainline analyses, merge/diverge analyses, and ramp terminal intersections analyses.

2.2 Performance Measures

Performance measures, or Measures of Effectiveness (MOE), quantitatively evaluate the transportation system. The intent of these measures is to provide comparative criteria for decision making purposes. This “Existing Traffic Conditions” technical memorandum illustrates the current traffic operating conditions which will be used to provide context to evaluation of future conditions. The criteria determined effective for this stage of the I-15 analysis include:

- Ramp intersections: level of service (LOS) and delay using Synchro 6.0
- Ramp merge/diverge: merge/diverge analysis using Highway Capacity Software (HCS) 2000
- I-15 mainline: mainline analysis using HCS 2000
- Supplemental field observation of the traffic conditions

It is essential that the scenario analysis consider the measures of effectiveness collectively rather than individually. By themselves, these measures of effectiveness show only a small portion of the complete picture, particularly under congested conditions.

2.2.1 Intersection Level of Service Criteria

To evaluate the existing conditions at major intersections located within the study area, existing delays per vehicle and intersection Levels of Service (LOS) were calculated using methodologies outlined in the (Transportation Research Board, 2000) Highway Capacity Manual, 2000 Methodology (HCM). LOS is the industry standard for describing the operating performance of an intersection or roadway. LOS is measured quantitatively and reported on a scale from A to F, with A representing the best performance and F the worst. Table 3 provides a brief description of each intersection LOS letter designation and an accompanying average delay per vehicle.

Table 3 I-15 Kaysville to Ogden Study <i>Level of Service Descriptions</i>		
Level of Service	Description of Traffic Conditions	Average Delay (seconds/vehicle)
SIGNALIZED INTERSECTIONS¹		
A	Extremely favorable progression and a very low level of control delay. Individual users are virtually unaffected by others in the traffic stream.	$0 \leq 10.0$
B	Good progression and a low level of control delay. The presence of other users in the traffic stream becomes noticeable.	$> 10.0 \text{ and } \leq 20.0$
C	Fair progression and a moderate level of control delay. The operation of individual users becomes somewhat affected by interactions with others in the traffic stream.	$>20.0 \text{ and } \leq 35.0$
D	Marginal progression with relatively high levels of control delay. Operating conditions are noticeably more constrained.	$> 35.0 \text{ and } \leq 55.0$
E	Poor progression with unacceptably high levels of control delay. Operating conditions are at or near capacity.	$> 55.0 \text{ and } \leq 80.0$
F	Unacceptable progression with forced or breakdown operating conditions.	> 80.0
UNSIGNALIZED INTERSECTIONS²		Worst Approach Delay (seconds/vehicle)
A	Free Flow/Insignificant Delay	$0 \leq 10.0$
B	Stable Operations/Minimum Delays	$>10.0 \text{ and } \leq 15.0$
C	Stable Operations/Acceptable Delays	$>15.0 \text{ and } \leq 25.0$
D	Approaching Unstable Flows/Tolerable Delays	$>25.0 \text{ and } \leq 35.0$
E	Unstable Operations/Significant Delays Can Occur	$>35.0 \text{ and } \leq 50.0$
F	Forced Flows/Unpredictable Flows/Excessive Delays	> 50.0
Source: 1. Fehr & Peers Descriptions, based on <i>Highway Capacity Manual, 2000 Methodology</i> (Transportation Research Board, 2000). 2. Fehr & Peers Descriptions, based on <i>Highway Capacity Manual, 2000 Methodology</i> (Transportation Research Board, 2000).		

2.3 Existing Traffic Operations Results

2.3.1 Ramp Terminal Intersections

The p.m. peak hour LOS was computed for each study intersection using the software Synchro 6.0. Table 4 reports the LOS and delay results for the existing traffic conditions analysis.

Detailed intersection LOS reports have been included in Appendix B.

Table 4 I-15 Kaysville to Ogden Study Existing (2004) Background PM Peak Hour Level of Service			
Signalized Intersections			
Intersection	Overall Intersection		
	LOS ¹	Average Delay (Sec/Veh) ²	
SR 273 and I-15 NB Ramps	C	20.9	
SR 273 and I-15 SB Ramps	C	27.1	
SR 126 and I-15 NB Ramps	B	14.8	
SR 232 and I-15 SB Ramps	C	34.6	
SR 232 and I-15 NB Ramps	C	32.9	
SR 108 and I-15 SB Ramps	D	35.6	
SR 108 and I-15 NB Ramps	E	55.1	
SR 193 and I-15 SB Ramps	C	31.4	
SR 193 and I-15 NB Off Ramp	B	14.6	
SR 103 and I-15 SB Ramps	C	30.9	
SR 103 and I-15 NB Ramps	D	37.7	
SR 97 and I-15 SB Ramps	B	11.7	
SR 97 and I-15 NB Ramps	D	40.7	
Unsignalized Intersections			
Intersection	Worst Movement		
	LOS ¹	Movement ¹	Delay (Sec/Veh) ¹
SR 126/I-15 SB On Ramp/900 East	B	Eastbound Approach	14.5
SR 193 and I-15 NB On Ramp	F	Eastbound Left	>50.0
SR 26 and I-15 SB On Ramp	NA	Free Flow	NA
SR 26 and I-15 NB Off Ramp	NA	Free Flow	NA
SR 79 and I-15 SB to WB On Ramp	A	Southbound Right	9.6
SR 79 Clover Interchange	NA	Free Flow	NA
1. This represents the worst approach and/or movement LOS and delay (seconds/vehicle) and is only reported for unsignalized intersections.			
2. This represents the overall intersection LOS and delay (seconds/vehicle).			
Source: Fehr & Peers Associates, Inc. September 2004.			

2.3.2 Freeway Ramp Merge/Diverge Analysis

A ramp junction is an area of competing traffic demands. Entering on-ramp vehicles competes for spaces with upstream freeway traffic in merge areas. In a merge area, individual on-ramp vehicles attempt to find gaps in the adjacent freeway lane traffic stream. The action of individual merging vehicles entering the traffic stream introduces turbulence to traffic flow in the vicinity of the ramp gore area. Approaching freeway vehicles move toward the left to avoid this turbulence, or create gaps for entering vehicles.

Conversely, at the off-ramp, the basic maneuver is a diverge, that is, a single traffic stream separating into two streams. Exiting vehicles must occupy the lane adjacent to the off-ramp. Thus, as the off-ramp is approached, diverging vehicles move right. This has a redistributing effect on other freeway vehicles, as they move left to avoid the turbulence of the immediate diverge area.

Ramps have a limited storage capacity. If capacity is exceeded at the merge point, local congestion and queuing occurs, which may ultimately spill back onto the urban arterial network. The same is true for diverging vehicles. If capacity is exceeded at the diverge point, queuing can back onto the freeway mainline. Both queuing scenarios should be avoided; however, it is generally accepted that queuing onto the freeway mainline is less desirable. This is because the severe traffic incidents can occur as a result of the high speed differential between freeway traffic and slow or stationary traffic attempting to leave the freeway. HCS 2000 LOS for each of the study area merge and diverge points are shown on Table 5.

Table 5 I-15 Kaysville to Ogden Study <i>Merge/Diverge LOS</i>					
Northbound					
Merge Point			Diverge Point		
On Ramp	Volume	LOS	Off Ramp	Volume	LOS
<i>SR 273</i>	878	E	<i>SR 273</i>	692	D
<i>SR 232</i>	581	D	<i>SR 126</i>	976	D
<i>SR 108</i>	973	D	<i>SR 232</i>	963	C
<i>SR 193</i>	883	D	<i>SR 108</i>	789	C
<i>SR 103</i>	738	D	<i>SR 193</i>	420	D
<i>SR 97</i>	349	E	<i>SR 103</i>	836	D
<i>I-84</i>	571	D	<i>SR 97</i>	434	E
<i>SR 79 EB to NB</i>	184	C	<i>SR 26</i>	1107	D
<i>SR 79 WB to NB</i>	381	F	<i>SR 79 NB to EB</i>	743	C
			<i>SR 79 NB to WB</i>	204	C
Southbound					
Merge Point			Diverge Point		
On Ramp	Volume	Merge LOS	Off Ramp	Volume	Diverge LOS
<i>SR 273</i>	414	C	<i>SR 273</i>	1025	D
<i>SR 126</i>	512	D	<i>SR 232</i>	617	D
<i>SR 232</i>	651	D	<i>SR 108</i>	797	D
<i>SR 108</i>	675	C	<i>SR 193</i>	793	D
<i>SR 193</i>	503	C	<i>SR 103</i>	393	D
<i>SR 103</i>	700	D	<i>SR 97</i>	325	C
<i>SR 97</i>	635	C	<i>I-84</i>	634	C
<i>SR 26</i>	1073	D	<i>SR 79 SB to WB</i>	89	D
<i>SR 79 WB to SB</i>	698	C	<i>SR 79 SB to EB</i>	430	D
<i>SR 79 EB to SB</i>	351	C			
<i>Source: Fehr & Peers Associates, Inc. September 2004.</i>					

As shown in Table 5, the SR-79 interchange currently has a merge point that is failing. This interchange was studied in the *I-15 31st Street to 2700 North EIS* which recommended a reconfiguration of this interchange. It is assumed that the reconfiguration of the interchange will improve the traffic operations. Overall, most of the points are at the C/D threshold, indicating that the movements are approaching capacity. Refer to Appendix C for detailed analysis. HCS analysis is a fairly simplistic analysis method but can be considered reliable in good traffic operating conditions where traffic operations at one location (i.e. a diverge point) are not sufficiently poor to impact adjacent locations (i.e. the freeway mainline upstream of the diverge point). In conditions where HCS indicated failing levels of service, it is recommended that a more sophisticated operational analysis of the particular location and its impact area be performed before conclusions leading to decisions on highway improvement projects be made.

2.3.3 Freeway Mainline Analysis

Basic freeway segments are those areas outside the influence of the ramp merge/diverge areas, or areas where considerable traffic weaving occurs. Operating conditions on the basic freeway segments primarily result from interactions among vehicles and drivers in the traffic stream and the influence of the geometric characteristics of the freeway. Operations can also be affected by environmental conditions, such as weather or lighting, by pavement conditions, and by incidents.

Though speed is a major concern of drivers as related to service quality, freedom to maneuver within the traffic stream and proximity to other vehicles are equally noticeable. These qualities are related to the density of the traffic stream. Unlike speed, density increases as flow increases up to capacity, resulting in a measure of effectiveness that is sensitive to a broad range of characteristics.

In order to understand the current traffic operational conditions on I-15 an HCS 2000 basic freeway segment LOS analysis was performed. The results can be viewed in Table 6. Refer to Appendix C for detailed analysis.

Table 6 I-15 Kaysville to Ogden Study <i>I-15 Mainline LOS</i>					
Segment	Lanes N / S	Southbound Volume	Southbound LOS	Northbound Volume	Northbound LOS
<i>SR 273 to SR 126</i>	3 / 3	4544	D	5543	E
<i>SR 126 to SR 232</i>	3 / 3	4032	C	4567	D
<i>SR 232 to SR 108</i>	3 / 3	4034	C	4185	C
<i>SR 108 to SR 193</i>	3 / 3	3856	C	4369	D
<i>SR 193 to SR 103</i>	3 / 3	4146	D	4832	D
<i>SR 103 to SR 97</i>	3 / 3	3839	C	4734	D
<i>SR 97 to SR 26</i>	3 / 3	3529	C	4649	D
<i>SR 26 to I-84</i>	3 / 3	2456	B	3542	C
<i>I-84 to SR 79</i>	3 / 3	3090	C	4113	D
<i>Source: Fehr & Peers Associates, Inc. September 2004.</i>					

As shown in Table 6, on I-15 northbound between SR-273 and SR-126, the mainline is operating at an LOS E. Most other locations are approaching capacity with a mainline LOS of C/D. Appendix D contains mainline LOS calculations.

A summary of the mainline, merge/diverge, and ramp terminal intersection LOS can be viewed on Figure 4.

2.3.4 Traffic Field Observations

The software programs Synchro 6.0 and HCS 2000 are deterministic tools which use average driver characteristics including: aggressiveness, gap acceptance, start-up lost time, acceleration, deceleration, etc. Even Synchro makes little adjustment for the interaction between closely spaced intersections; especially when queuing and intersection spill back is occurring. As such, considering the geometric constraints of closely spaced intersections, supplemental traffic observation provides valuable insight as to the existing traffic operational conditions.

The following notes document some of the additional findings that were observed in the field.

200 North (SR-273):

The ramp terminal intersections at this interchange operate reasonable well. There does not appear to be significant intersection queuing during the PM peak period. As such, the Synchro LOS designation is an accurate representation of the traffic observations.

Existing Traffic Observations:

- Eastbound Left turn onto Northbound 400 West has a fair amount of queuing and traffic. This has the potential to queue back into the Northbound off ramp intersection causing additional congestion. Eliminating eastbound lefts from this intersection may improve overall conditions. 300 West could provide an alternative route.
- Pedestrian sidewalks under the overpass are substandard or nonexistent.

Fort Lane (Northbound off-ramp):

No significant traffic operational problems at this interchange. The Synchro LOS designation is an accurate representation of the traffic conditions. There are no closely spaced intersections, as a result, there is no queuing and intersection spill-back.

Main Street (Southbound on-ramp):

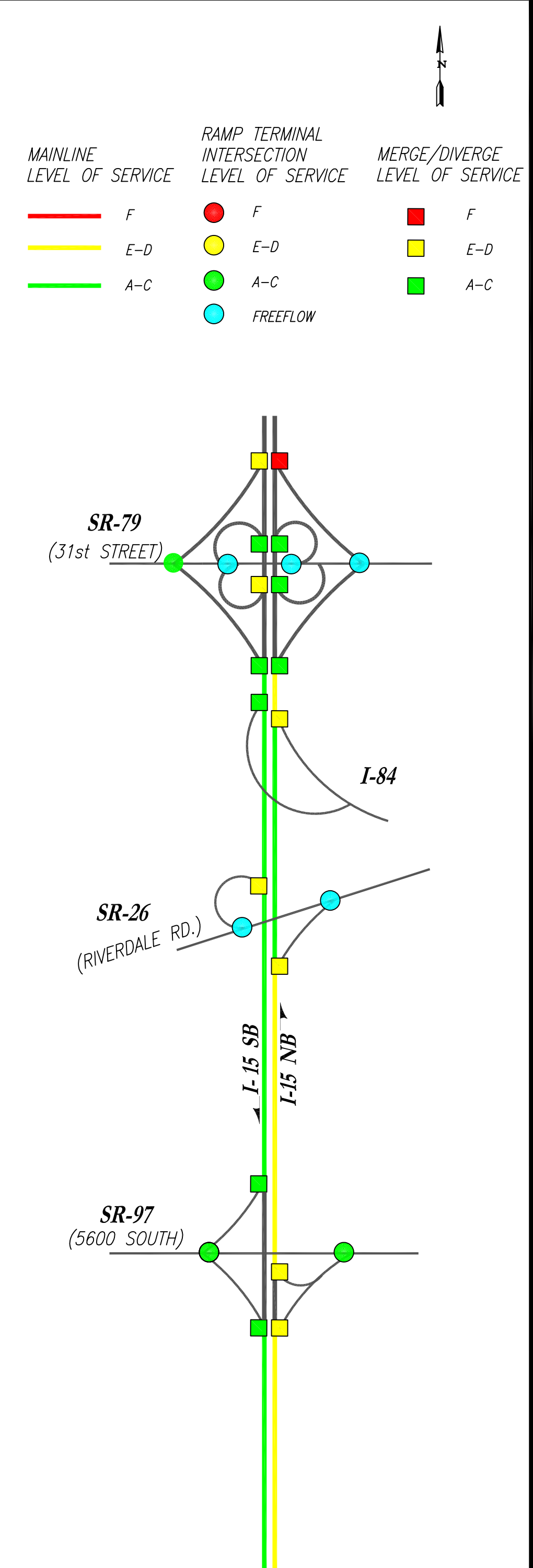
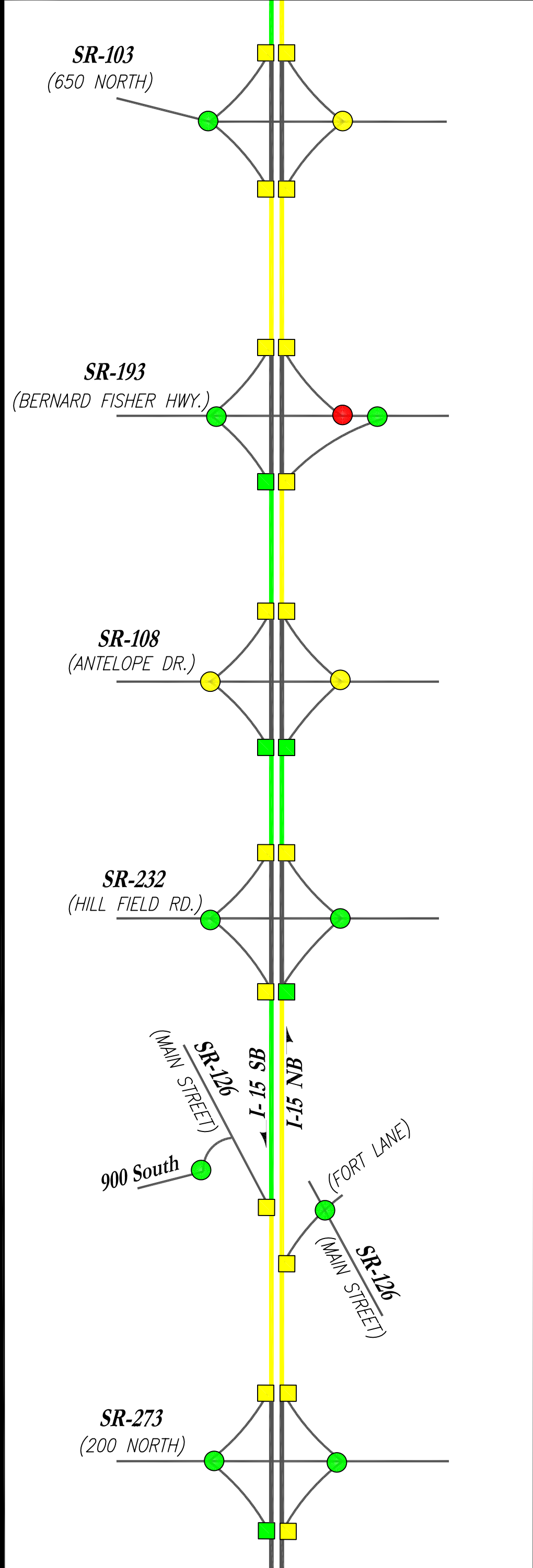
This intersection operates very well. There is adequate capacity. The Synchro LOS designation is an accurate representation of the traffic observations.

Hillfield Road (SR-232):

Of all the interchanges along the corridor this one appears to have the most delay. There is excessive intersection spill back and queuing at the off-ramps. This congestion appears to be caused from delay/congestion at the Hillfield Road/Main Street intersection. The degree of delay caused by queues backing through adjacent intersection is underestimated by the Synchro analysis, even though the calculations indicate a LOS of C.

Existing Traffic Observations:

- During the green phase, cars remain idle because of the intersection blockage that is the result of spill back from the nearby intersection. Spill back is occurring from Main Street and Gordon Avenue.



- Ramp storage capacity is insufficient. Due to the blocking, vehicles are queuing back onto the mainline of I-15. This is creating a potential safety hazard and delay not represented by the Synchro/HCS LOS analysis.
- The surface-street left turn storage is insufficient (on Hillfield Road). There is overlapping stacking for vehicles traveling both eastbound and westbound, often blocking the through lanes.

Antelope/Syracuse Drive (SR-108):

This interchange seems to have sufficient capacity for through-travel on Antelope Drive but has insufficient capacity for turns on and off the I-15 ramps. There is excessive queuing from the ramp terminal intersections. This is probably not reflected in the Synchro analysis.

Existing Traffic Observations:

- The northbound off-ramps have critical capacity issues (largely due to insufficient left turning capacity). Vehicles often back onto I-15 mainline.
- The southbound off-ramp has a fair amount of queuing for right turning vehicles.
- Queues exceed available storage for the eastbound left turn on to the northbound on ramp.
- Queues exceed available storage for the southbound right movement at Angel Street (east frontage road).

Bernard Fisher Hwy (SR-193):

Overall this interchange operates reasonably well. There are a some left turn pockets that would benefit from additional storage capacity. The Synchro LOS designation is an accurate representation of the traffic observations.

Traffic Conditions:

- The eastbound to northbound left-turn lane has queuing approaching the southbound ramps.
- The westbound left turn lane at Main Street (1900 W) has queuing. It nearly approaches the southbound/I-15 ramp.

650 North:

This interchange is close to the Hill Air Force Base entrance. With the high traffic volume existing at the Base during the p.m. peak period, congestion occurs. This is probably not reflected by the Synchro analysis.

Traffic Conditions:

- Congestion is largely experienced by vehicles attempting to travel westbound from the interchange. This includes both vehicles exiting the Base and those traveling from the I-15 northbound ramps.
- There is excessive queuing for northbound left turning vehicles at the northbound ramp intersection.

5600 South (SR-97):

Overall, this interchange operates better than many of the other interchanges. There are some capacity constraints, which are largely due to the close proximity to 1900 West. The Synchro LOS designation is an accurate representation of the traffic observations.

Traffic Conditions:

- There is queuing on the northbound off ramp for left turning vehicles. Excessive queuing from the 1900 West intersection causes this problem.

Riverdale Road:

All of the ramp points are free-flow. As such, there does not appear to be any traffic operation problems currently.

2.4 I-15 Corridor Conclusions

Overall, conditions on the I-15 mainline and at the merge/diverge points are operating reasonably well during the p.m. peak period. Though they operate acceptably now, these sections are operating near capacity meaning future growth in traffic will result in increased congestion and delay.

The findings from field observations indicate that more sophisticated traffic operational analyses will be required for refined alternatives analyses at certain locations within the study area. The traffic operations analysis methodology applied initially across the entire study area, HCS for I-15 merge/diverge points and mainline operations and Synchro for the ramp terminal signalized intersection operations, have some limitations. This methodology does not accurately represent the impacts to the ramp terminal signalized intersections of adjacent, poorly operating intersections. In these circumstances, it is understood that traffic conditions could be considered failing and benefit can be gained through capacity improvements.

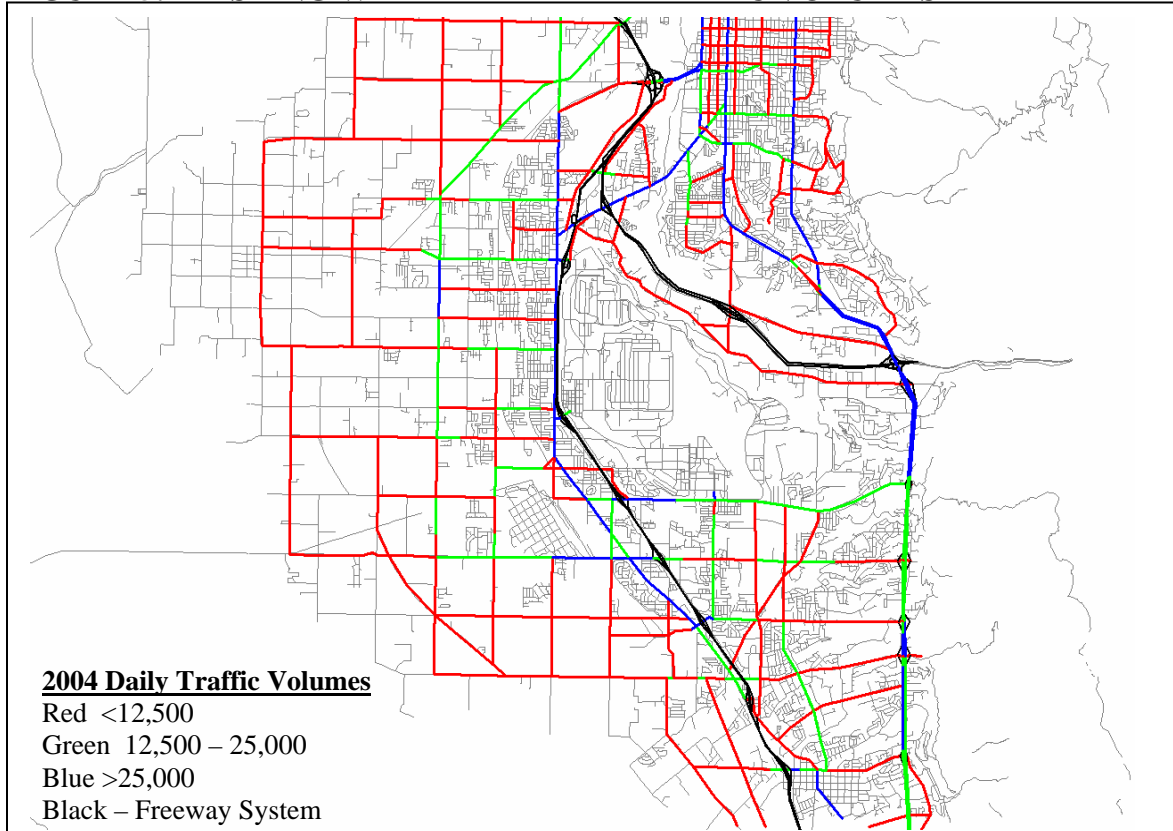
3.0 Surface Street Network

3.1 Data Collection

Data included with releases of Wasatch Front Regional Council's (WFRC) Travel Demand Models were relied upon to draw conclusions about the current operation of the surface street network of collectors and arterials. The WFRC works extensively with the State and local jurisdictions, and as part of the regional planning process to keep a set of base-year traffic counts, an inventory of the configuration of the existing transportation network, and a dataset that reflects changes to demographics, travel demand and planned improvements to the transportation system. As such, the WFRC has available data that reflects existing and future conditions according to current best planning. This data were relied upon for the existing conditions traffic analysis since it is comprehensive, up to date, and immediately available.

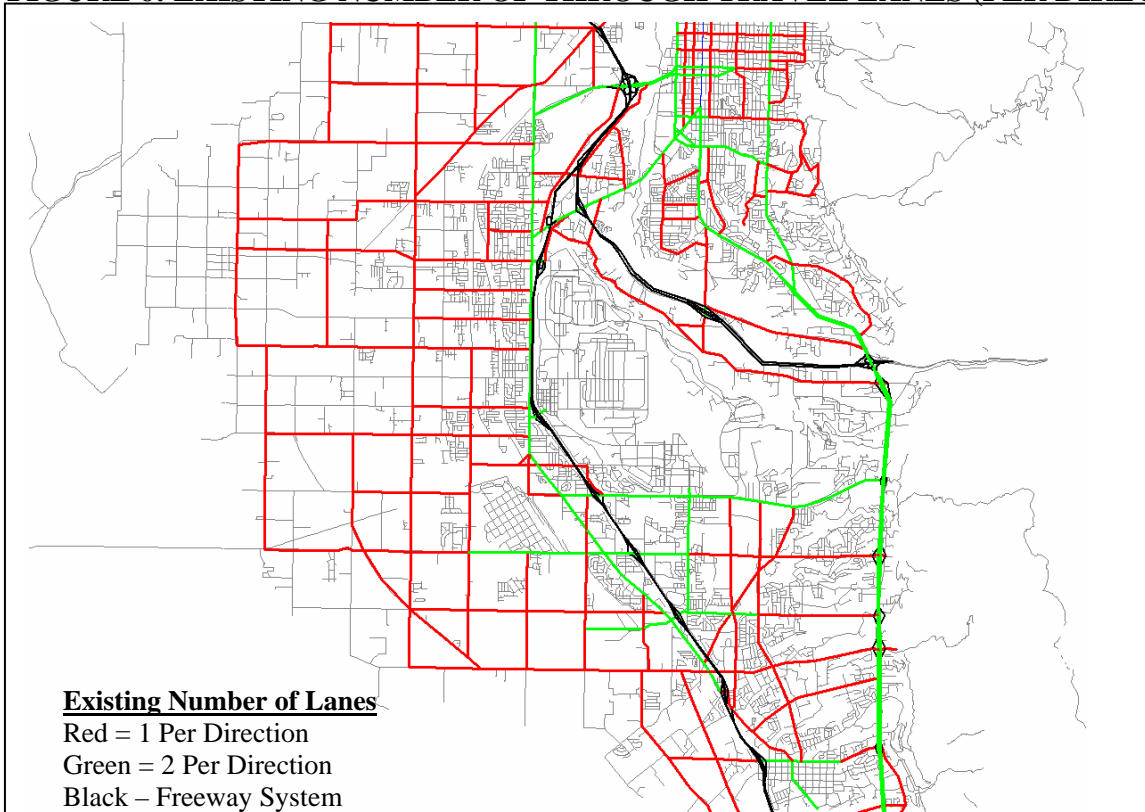
As this project progresses, sub-areas within the study area may become of particular interest. At that time, more detailed data regarding existing traffic conditions may be gathered as appropriate. Figure 5 indicates current weekday daily traffic volumes. Thresholds for traffic volumes were selected as a 'rule-of-thumb' indicator that suggests at a high planning level whether a road may experience traffic operational failure during peak periods. Generally, it could be assumed that the capacity of a road with one through lane per direction is approximately 12,500 vehicles per day, the capacity of a road with two through lanes per direction could be considered approximately 25,000 vehicles per day. Figure 6 shows the current number of through lanes for each facility (collectors and arterials).

FIGURE 5: EXISTING WEEKDAY DAILY TRAFFIC VOLUMES



Source: 2004 v4.1 Loaded Network, Fehr & Peers

FIGURE 6: EXISTING NUMBER OF THROUGH TRAVEL LANES (PER DIRECTION)



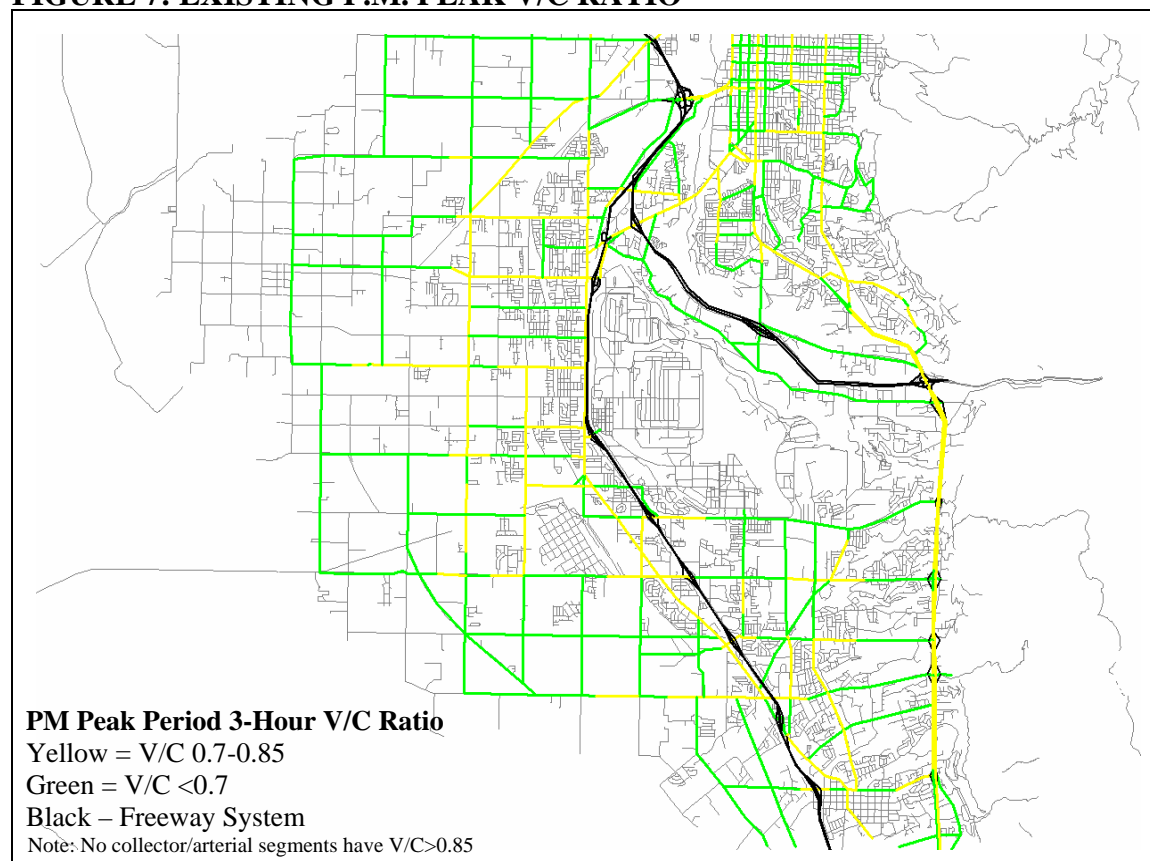
Source: v4.1 Master Network, Fehr & Peers

3.2 Traffic Operations

To describe the existing traffic operations of the entire surface street network, we will compare the peak period traffic volumes (estimated for 2004, based upon 2001,2002 data) with a comparison of each roadway segment's capacity. Traffic operations for a surface street network are generally controlled by roadway intersections, sometimes by driveway configurations, and occasionally by unusual roadway geometrics. To accurately evaluate traffic operations based on the exact configuration of the roadway and traffic control system would require extensive data collection and involved analyses. As a guide, or indicator of current traffic operational conditions, data included in the WFRC travel demand model were relied upon.

Figure 7 shows the Volume to Capacity Ratio (v/c) for each segment of collector or arterial in the I-15 Study Area during the p.m. peak period. Three-hour traffic volumes are compared to the capacity of each segment from 4 p.m. until 7 p.m. Street segment capacities are based on the street functional classification, posted speed limit, intersection and driveway density, etc, and so are intended to reflect not the capacity of a segment of road, rather, the maximum number of vehicles that could be served along this segment given its configuration relative to the rest of the transportation network (a 2 lane road with no intersections or driveways has a higher practical capacity than a two lane road with ¼ mile signal spacing and numerous driveways). The three-hour peak period is the greatest level of refinement that traffic demand on the highway system is calculated to by the WFRC travel demand model. Detailed interpretations should be made with caution.

FIGURE 7: EXISTING P.M. PEAK V/C RATIO



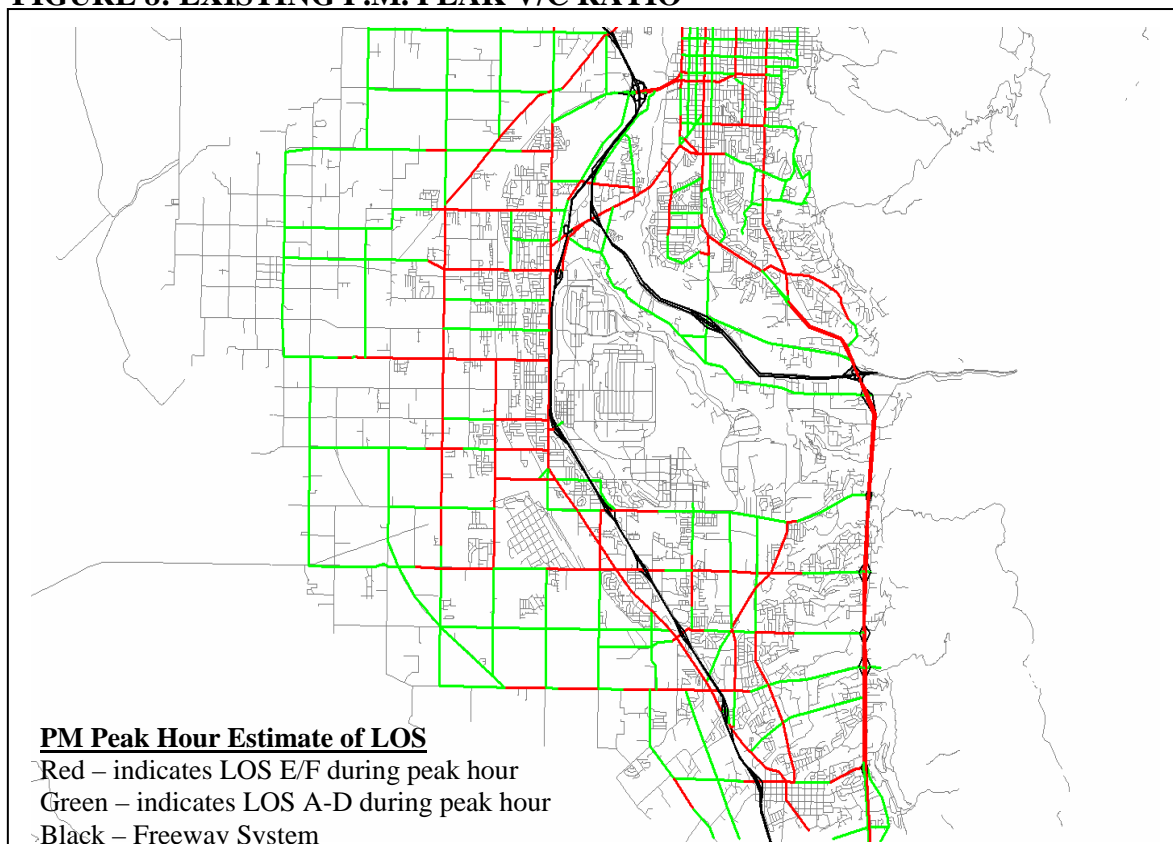
Source: 2004 v4.1 Loaded Network, Fehr & Peers

Figure 7 indicated that traffic conditions throughout the western edge of the study area are, in general, satisfactory. Traffic conditions get worse throughout the areas that are currently more developed and along US-89. No segments currently see a three-hour demand level that closely approaches or exceeds 3-hour capacity (an indicator of significant congestion). This does not imply that during peak hours the existing surface street network does not experience periods of operational failure, or demand exceeding capacity.

A review of Figure 3 shows that currently traffic demand does tend to have one peak demand hour within the peak 3-hour period, though the variation of hourly travel demand is not great. Review of the description of LOS E conditions for signalized intersections in Table 3 indicate that at LOS E conditions traffic approaches capacity. To get an indication of whether surface streets experience LOS E or F conditions during the one peak hour within the three-hour peak period using the travel demand model, another step can be taken.

The one-hour lane capacity is simply one third of the three-hour lane capacity. The peak hour demand is usually approximately 10 percent higher than one third of the three-hour peak period demand (this is shown in Figure 3 and is a result that is frequently seen on surface streets along the Wasatch Front). LOS D conditions (the LOS D/E threshold) occurs for surface streets at approximately 70 percent of capacity. A three-hour V/C from the travel model that exceeds 0.65 is an indicator of peak hour conditions of LOS E and F. Figure 8 shows the extent of highway segments throughout the study area that may currently be operating at LOS E or F during the p.m. peak hour.

FIGURE 8: EXISTING P.M. PEAK V/C RATIO

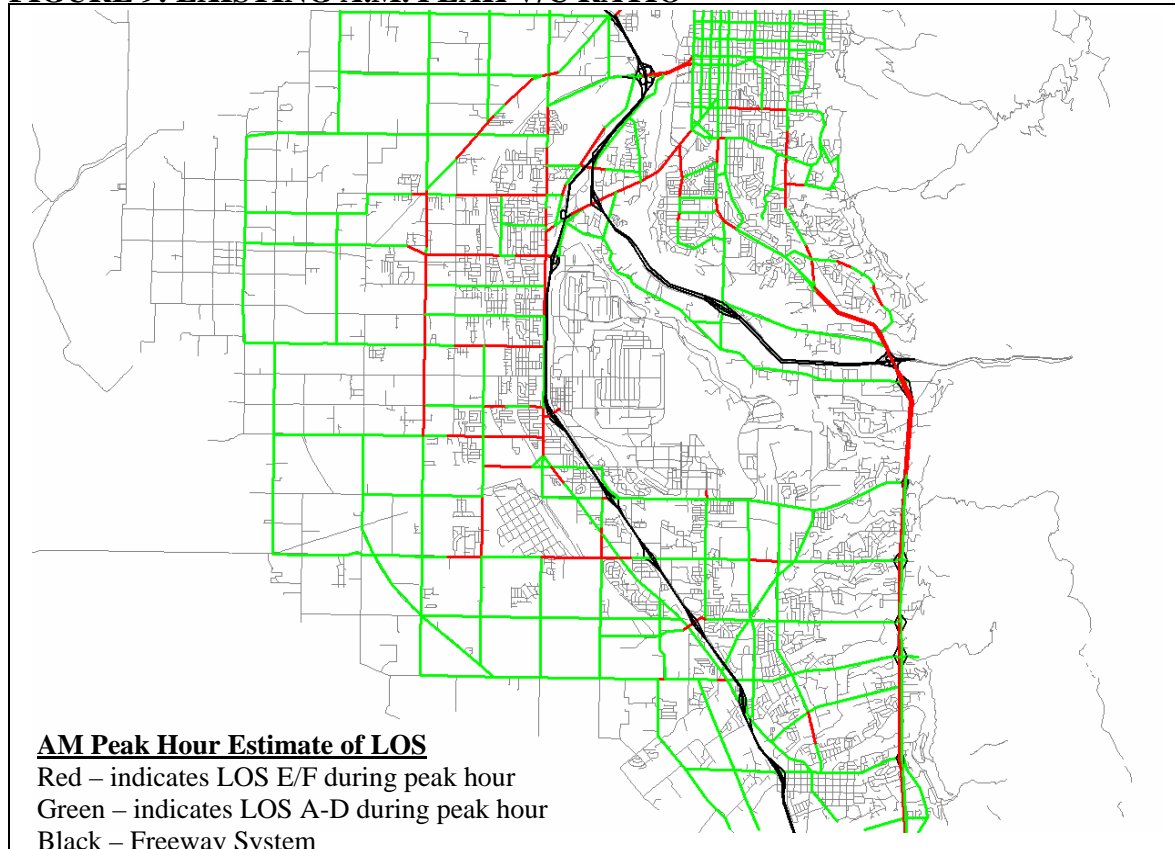


Source: 2004 v4.1 Loaded Network, Fehr & Peers

It is reasonable to conclude that a significant portion (perhaps 40 percent) of the surface street network experiences some operational failure during the p.m. peak hour. The general distribution of the worst traffic conditions tends to follow the geographic distribution of the majority of existing development. That also is an unfortunate indicator that there are few significantly developed areas that would not experience some traffic operational failure during the p.m. peak hour.

For purposes of comparison, Figure 9 shows the same data as Figure 8, except for the a.m. peak hour.

FIGURE 9: EXISTING A.M. PEAK V/C RATIO



Source: 2004 v4.1 Loaded Network, Fehr & Peers

Traffic conditions during the a.m. peak period are better than those during the p.m. peak, though there are still some areas that suggest traffic operation is at LOS E or F.

3.3 Surface Street Network Conclusions

The analyses presented above provide a strong indication that a significant portion of the surface street network currently experiences traffic conditions that are LOS E or F during the p.m. peak hour. Areas experiencing the worst congestion tend to follow the current development pattern. Conditions during the a.m. peak hour are much better though a few locations throughout the study area experience LOS E and F conditions.